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Automatic detection of spurious touch inputs

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ABSTRACT

Many users rest the palm of their hand on the screen when writing or interacting with a tablet or other touchscreen device. Spurious strokes can be generated from such touch, causing problems such as accidental activation of application modes or incorrect input. This disclosure describes the use of machine learning techniques to differentiate between valid and spurious strokes.

KEYWORDS

- Palm rejection
- Touchscreen
- Trackpad
- Ghost touch
- Spurious touchscreen event
- Inadvertent input
- Machine learning

BACKGROUND

Many users rest the palm of their hand on the screen when writing or interacting with a tablet or other touchscreen device. Spurious strokes can be generated from such touch, causing problems such as accidental activation of application modes or incorrect input. For example, a spurious touch of a palm by a user while drawing on a touch screen device can result in an unintended rotation of the screen, unintended zooming, etc. Similarly, other accidental touches, such as touches at the edge of a device when the device is being held, can cause spurious input that can interfere with the application or user interface. Although heuristics exist that attempt to

detect spurious detect palm touches, e.g., by sensing that the size of the touch is too large to be a standard finger input, such heuristics are of insufficient accuracy or reliability.

DESCRIPTION

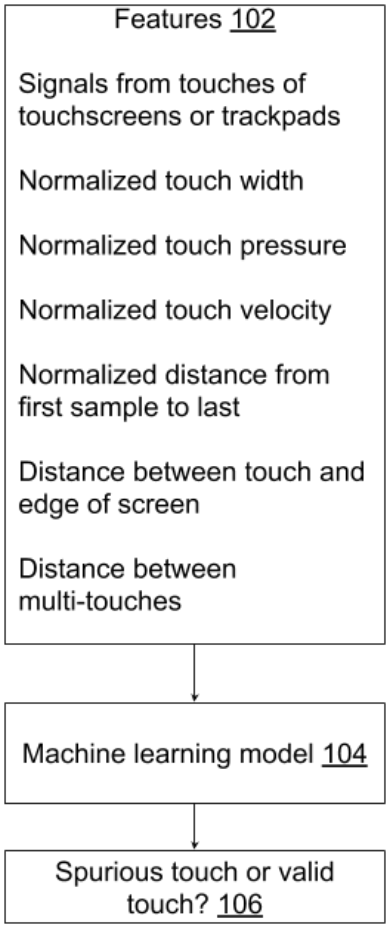

Fig. 1: Detecting spurious touches on touchscreens or trackpads

Fig. 1 illustrates detecting spurious touches on touchscreens or trackpads, per techniques of this disclosure. Signals from finger or palm touches of touchscreens or trackpads, e.g., normalized touch width, normalized touch pressure, normalized touch velocity, normalized distance from first sample to last, distance of touch from the edge of the screen, distance between multi-touches, etc. are fed as features (102) to a trained machine learning model (104). The model determines if the touch is valid or spurious (106).

The machine learning model is trained with labeled training data captured from different types of touch surfaces. During operation, touch events are captured in real time, and when sufficient events have been captured, a feature vector is generated from the stroke. The machine learning model uses the feature vector to determine if the stroke is spurious or valid. If a touch stroke is identified as spurious, a cancel event is issued and the stroke is discarded. Further, the samples of input may be buffered, such that if the stroke is identified as spurious, the buffer is discarded, and if the stroke is identified as valid, the buffer is played back.

The machine learning model can internally use various attributes of touches to differentiate between spurious and deliberate strokes, such as the following.

- Size: Compared to genuine touches, sizes of spurious touches tend to vary rapidly, e.g., jump around.
- Velocity and acceleration: Compared to genuine touches, spurious touches have relatively low velocity and acceleration.
- Stroke direction: Compared to genuine touches, spurious touches tend to rapidly change direction.
- Touch-point clustering: Compared to genuine touches, spurious touches tend to cluster as a collection of small points in a region.
- Touch-point ephemerality: Compared to genuine touches, spurious touches tend to appear and disappear over time.
- Touch-point locations: Compared to genuine touches, spurious touches tend to fall in certain locations with respect to the position of a stylus.

The machine learning model can be built based on the following specifications. These specifications can also inform the choice of the type of model used, e.g., neural networks, support vector machines, etc.

- High accuracy: Both false positives, e.g., valid stroke classified as a spurious touch, and false negatives, e.g., a spurious touch classified as a valid stroke, are to be minimized.
- Low latency: The machine learning model is to detect spurious touches with low latency, such that strokes identified as spurious are immediately canceled by the device.
- Support across devices: The machine learning model is to work across a range of devices with different resolutions, responses, stylus technologies, etc.
- Support across user types: Spurious touch detection is reliable across the user population, e.g., works consistently for left-handed and right-handed users, users of differing ages, geographical regions, etc.
- Simplicity: Spurious touch detection works within the input stack at a relatively low layer. It is therefore to be of low computational complexity.

Signals from the touchscreen or trackpad are obtained over an optimum duration to ensure that sufficient data is collected to make a reliable determination while meeting latency requirements. For example, a signal-collection duration of 80 milliseconds enables the quick and reliable detection and cancelation of spurious touches before they can have unintended user-interface effects. Users are provided with options regarding how the described techniques are implemented, including how touch data is obtained and used, and to turn off spurious touch detection.

Certain spurious touches, e.g., very short, light palm touches, are difficult to differentiate from short, deliberate taps. These almost always occur in close proximity to other spurious

touches. To handle such touches, a set of samples are found that are nearest in both time and coordinates to the centroid of the stroke being classified and features from these samples (e.g. width, pressure, velocity) are additionally included in the feature vector for that stroke. These additional neighboring sample features can significantly increase the accuracy of the palm rejection on short, light palm touches.

The machine learning model can be trained to favor false negatives, e.g., spurious strokes classified as legitimate, over false positives, e.g., legitimate strokes classified as spurious. For example, this choice can be made based on user experience assessment that indicates that it is worse user experience when a legitimate stroke is discarded than to not reject a spurious palm touch.

CONCLUSION

This disclosure describes the use of machine learning techniques to differentiate between valid and spurious strokes on a touchscreen or trackpad. A trained machine-learning model is used to detect and reject spurious touches. The model type and complexity can be chosen based on design specifications and capabilities of the device or device family on which the spurious touch detection is implemented.